CLAIMS:

What is claimed is:

1. Apparatus for converting the output signals of a logging tool into a log representing a parameter of earth formations surrounding a borehole, comprising:

an artificial neural network trained with a set of synthetic earth formation models selected to cover the operating range of a selected logging tool based on sensitivity and resolution limits of the logging tool and based on realistic ranges of formation parameters.

2. Apparatus according to Claim 1 wherein:

said logging tool output signals are a series of samples each representing the signal at a depth point in said borehole, and

said neural network has a plurality of inputs receiving the samples from a range of depths in the borehole and one output representing the parameter at a depth point within the range of depths.

3. Apparatus according to Claim 1 wherein:

said logging tool output signals are a series of samples each representing the signal at a depth point in said borehole, and

said neural network has a plurality of inputs receiving the samples from a range of depths in the borehole and a plurality of outputs representing the value of the parameter at a plurality of depth points within the range of depths.

4. Apparatus according to Claim 3, further comprising:

means for combining the outputs of said neural network to generate an average value for each depth point in the borehole.

5. A method for converting the output signals of a logging tool into a log representing a parameter of earth formations surrounding a borehole, comprising:

creating a set of synthetic earth formation models selected to cover the operating range of a selected logging tool based on sensitivity and resolution limits of the logging tool and based on realistic ranges of formation parameters;

generating synthetic responses of the selected tool to each of the formation models;

using the synthetic responses and the formation models to train an artificial neural network to generate the formation models in response to the synthetic responses; and

processing actual logging signals from the selected tool with the trained neural network to produce a log of the earth parameter.

6. The method of Claim 5, further comprising;

using the synthetic responses and the formation models to train one or more additional artificial neural network or networks to generate the formation models in response to the synthetic responses;

processing the actual logging signals from the selected tool with the additional trained neural network or networks to produce an additional log or logs of the earth parameter; and,

combining the logs of the earth parameter to produce a composite log of the earth parameter.

7. The method of Claim 5, wherein the selected logging tool is an induction logging tool having more than one transmitter receiver pair and the synthetic responses from the selected tool include responses from more than one transmitter receiver pair.

8. The method of Claim 5, wherein the selected logging tool is an induction logging tool having both in-phase and quadrature output signals and the synthetic responses from the selected tool include both signals.

9. The method of Claim 5, wherein the artificial neural network has a plurality of outputs, each providing an output corresponding to a different depth point in the borehole, further comprising:

combining the plurality of outputs according to borehole depth points to produce a log of the earth parameter.

10. Apparatus for converting the output signals of a logging tool into a log representing a parameter of earth formations surrounding a borehole, comprising:

an artificial neural network trained with a set of synthetic earth formation models comprising;

a. a plurality of chirp models having continuously increasing layer thicknesses, each chirp model having parameter contrasts at layer interfaces limited to realistic contrasts found in actual earth formations, at least one model having an upper parameter limit substantially at the upper limit of the selected tool operating range, and at least one model having a lower parameter limit substantially at the lower limit of the selected tool operating range, and

b. a plurality of Oklahoma type models having parameter contrasts at layer interfaces limited to realistic contrasts found in actual earth formations, at least one model having an upper parameter limit substantially at the upper limit of the selected tool operating range and at least one model having a lower parameter limit substantially at the lower limit of the selected tool operating range.

11. The apparatus of Claim 10, wherein:

the logging tool is an induction logging tool having a ratio of maximum sensitivity to minimum sensitivity of about 10,000 to 1 and the chirp models include at least one model with parameter contrasts at layer interfaces of about 10 to 1 and at least one model with parameter contrasts at layer interfaces of about 100 to 1.

12. The apparatus of Claim 10 wherein:

the logging tool is an induction logging tool having a ratio of maximum sensitivity to minimum sensitivity of about 10,000 to 1 and the Oklahoma models have parameter contrasts at layer interfaces from about 10 to 1 to about 100 to 1.

13. A method for converting the output signals of a logging tool into a log representing a parameter of earth formations surrounding a borehole, comprising:

creating a set of synthetic earth formation models comprising;

a. a plurality of chirp models having continuously increasing layer thicknesses, each chirp model having parameter contrasts at layer interfaces limited to realistic contrasts found in actual earth formations, at least one model having an upper parameter limit substantially at the upper limit of the selected tool operating range, and at least one model having a

lower parameter limit substantially at the lower limit of the selected tool operating range, and

b. a plurality of Oklahoma type models having parameter contrasts at layer interfaces limited to realistic contrasts found in actual earth formations, at least one model having an upper parameter limit substantially at the upper limit of the selected tool operating range, and at least one model having an lower parameter limit substantially at the lower limit of the selected tool operating range;

generating synthetic responses of the selected tool to each of the artificial formation models;

using the synthetic responses and the formation models to train an artificial neural network to generate the formation models in response to the synthetic responses; and

processing actual logging signals from the selected tool with the trained neural network to produce a log of the earth parameter.

14. The method of Claim 13, wherein:

the logging tool is an induction logging tool having a ratio of maximum sensitivity to minimum sensitivity of about 10,000 to 1 and the chirp models include at least one model with parameter contrasts at layer interfaces of about 10 to 1 and at least one model with parameter contrasts at layer interfaces of about 100 to 1.

15. The method of Claim 13 wherein:

the logging tool is an induction logging tool having a ratio of maximum sensitivity to minimum sensitivity of about 10,000 to 1 and the Oklahoma models have parameter contrasts at layer interfaces from about 10 to 1 to about 100 to 1.

16. The process of Claim 13, further comprising;

using the synthetic responses and the formation models to train one or more additional artificial neural network or networks to generate the formation models in response to the synthetic responses;

processing the actual logging signals from the selected tool with the additional trained neural network or networks to produce an additional log or logs of the earth parameter; and,

combining the logs of the earth parameter to produce a composite log of the earth parameter.

17. The method of Claim 13, wherein:

the selected logging tool is an induction logging tool having more than one transmitter receiver pair and the synthetic responses from the selected tool include responses from more than one transmitter receiver pair.

18. The method of Claim 13, wherein:

the selected logging tool is an induction logging tool having both in phase and quadrature output signals and the synthetic responses from the selected tool include both signals.

19. The method of Claim 13, wherein the artificial neural network has a plurality of outputs, each producing an output signal representing a different depth point in the borehole, further comprising:

combining the outputs of the neural network according to depth points to produce a composite log of a formation parameter.

20. Apparatus for converting the output signals of an induction logging tool into a log representing a parameter of earth formations surrounding a borehole, comprising:

an artificial neural network trained with a set of synthetic earth formation models comprising;

a. a plurality of chirp models having continuously increasing layer thicknesses, and having parameter contrasts of from about 10 to 1 to about 100 to 1 at layer interfaces, each model having different upper and lower parameter limits, selected so that the highest and lowest parameter limits are substantially at the upper and lower limits of the selected tool operating range, and

b. a plurality of Oklahoma type models having parameter contrasts of from about 10 to 1 to about 100 to 1 at layer interfaces, each model having different upper and lower parameter limits, selected so that the highest

and lowest parameter limits are substantially at the upper and lower limits of the selected tool operating range.

21. A method for converting the output signals of an induction logging tool into a log representing a parameter of earth formations surrounding a borehole, comprising:

creating a set of synthetic earth formation models comprising;

a. a plurality of chirp models having continuously increasing layer thicknesses, and having parameter contrasts of from about 10 to 1 to about 100 to 1 at layer interfaces, each model having different upper and lower parameter limits, selected so that the highest and lowest parameter limits are substantially at the upper and lower limits of the selected tool operating range, and

b. a plurality of Oklahoma type models having parameter contrasts of from about 10 to 1 to about 100 to 1 at layer interfaces, each model having different upper and lower parameter limits, selected so that the highest and lowest parameter limits are substantially at the upper and lower limits of the selected tool operating range;

generating synthetic responses of the selected tool to each of the artificial formation models;

using the synthetic responses and the formation models to train an artificial neural network to generate the formation models in response to the synthetic responses; and

processing actual logging signals from the selected tool with the trained neural network to produce a log of the earth parameter.

22. The process of Claim 21, further comprising;

using the synthetic responses and the formation models to train one or more additional artificial neural network or networks to generate the formation models in response to the synthetic responses;

processing the actual logging signals from the selected tool with the additional trained neural network or networks to produce an additional log or logs of the earth parameter; and,

combining the logs of the earth parameter to produce a composite log of the earth parameter.

23. The method of Claim 21, wherein the selected logging tool has more than one transmitter receiver pair and the synthetic responses from the selected tool include responses from more than one transmitter receiver pair.

24. The method of Claim 21, wherein the selected logging tool provides both in phase and quadrature output signals and the synthetic responses from the selected tool include both signals.

25. The method of Claim 21, wherein the artificial neural network has a plurality of outputs, each producing an output signal representing a different depth point in the borehole, further comprising;

combining the outputs of the neural network according to depth points to produce a composite log of a formation parameter.